17. EIGHT MILLION NEOLITHIC EUROPEANS: SOCIAL DEMOGRAPHY AND SOCIAL ARCHAEOLOGY ON THE SCOPE OF CHANGE – FROM THE NEAR EAST TO SCANDINAVIA

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The organization of political institutions, social behaviour and the possibility of joint action is most dependent on the demographic size and development of societies. While 'demography' is just as important for social developments as 'economy', newly arising theoretical and methodological discourses on social demography and social archaeology have sharpened tools and interpretations for demographic considerations. With this background in mind, some results of archaeological research on demography are presented. For both the Near East and Europe, population calculations (6500–1500 BCE) put forth information on absolute values of population sizes and shifts in demographic development. The potential of the investigation is found in the interlinking of technological, social and demographic changes. For the first time, a combination of Near Eastern and European values is presented. On the one hand, they underline the structural difference between both supra-regions and, on the other hand, they verify demographic shifts and changes dependent in both areas on changes, *e.g.*, in subsistence technologies or social formation processes. Around 6000 BCE, about 1 million humans lived in Europe, whereas around 2000 BCE already nearly 8 million inhabitants lived on the continent. In consequence, a paradigm has changed: Archaeology of the twenty-first century is able to integrate demographic proxies into analyses from local to global scales.

Theories, methods, technologies

Archaeology of the twenty-first century, especially prehistoric archaeology, looks back on a huge variety of approaches in social and economic archaeology. Formerly, the reconstruction of individual and social behavior was evaluated and discussed according to

different approaches – from ecodeterministic identification of social cycles in combination with environmental constraints to the negotiation of social perceptions in the minds of individuals, neglecting the possibility of identifying social landscapes and the social mode of societies. Theoretical approaches rooted in structural Marxism, market philosophies or social psychology dealt, and continue to deal, with terms such as 'social group', 'identities', 'social mobility' and 'social stratification'.

As every generation of archaeologists and anthropologists must address progress and regress in theoretical approaches and methodological developments, the last 30 years saw the coming and going of philosophers used in archaeological discourses for arguments to reconstruct societies on the basis of material culture, anthropological data and diachronic perspectives. Additionally, the development of new methodological approaches and technical possibilities for archaeological analyses culminated in a constant application of new techniques, critiques of these techniques and the focusing of their scope for our inquiries. Meanwhile, a re-establishment of social archaeology seems to be necessary, which verifies a holistic interpretation of all the data, based on new technological possibilities for analyses. Reconstructing social archaeology means to integrate, criticize and verify the new possibilities of, *e.g.*, palaeodemographic studies, isotope analyses, aDNA-studies and new advantages of AMS-dating. On a theoretical basis, it is now time to write a new archaeological theory on the integration of different research categories for the reconstruction of the 'individual and society'.

Such a task is not straightforward and might be a never ending story. Nevertheless, in order to deal with the results of the recent technological revolution in archaeological methods, it becomes necessary for archaeologists to integrate paradigms of 'other' sciences into archaeological theorization. Apart from all the difficulties which arise in the interpretations, I am convinced that archaeology is a leading discipline in the fields of interpretation and historical reconstruction of general anthropological matters. With the advantages of diachronic perspectives, the contribution of archaeology to general questions sets precedents.

Population size matters

In this respect, I would like to deal with some remarks on one topic, which is of great importance not only as one of the manifold variables of regional and global environmental scenarios (including the aspect of demographic pressure on the environment), but also pivotal for the reconstruction of social processes in societies: the evaluation of population sizes and densities on different scales (from 'local' to 'global' scales). The size of a human group, which lives together in a domestic site or in a local area ('*Siedlungskammer*'), or the density of a population in a region is important for many economic and social aspects, *e.g.*, for:

- the spatial scale of horizontal networks (*e.g.* exogamy/endogamy of marriage practices);
- the character and range of political institutions necessary to organize daily and even generational life (Johnson and Earle 2000);
- the limitations or possibilities of joint economic activities dependent on group sizes (*e.g.* the organization of hunting, field rotation systems);

- the limitations or possibilities of economic tasks with work flows on specialized activities (*e.g.* flint extraction; metal production);
- the number of people, who could be gathered for single events (*e.g.* for the construction of a house, a burial mound);
- the creation of identities (even 'ethnic' identities);
- the flow of items and commodities between regions (*e.g.* the possibility or impossibility of hand-to-hand exchange in thinly populated areas).

In consequence, 'demography' is as important as 'economy' for societal life and organization. In the history of archaeology we observe (since the recognition of archaeology as an academic subject) fluctuations in the treatment of demographic questions, but it has just occurred during the previous decade that the development of scientific methods and modeling possibilities enabled a more secure identification of population values, even for prehistory. A threefold wave of advance in the reconstruction of population sizes can be identified. Firstly, early approaches in the second half of the nineteenth century already used figures on cereal production and processing in Attica and the Peloponnese for the evaluation of population densities (Beloch 1886). Secondly, above all in the 1980s the reconstruction of economic technologies deployed by prehistoric and ancient societies were used to calculate carrying capacities with respect to population densities – both in traditional European archaeology as well as in processual archaeology (Buck 1985; Poulsen 1983; Milisauskas and Kruk 1984; Hassan, 1981). Thirdly, as archaeological excavation and dating techniques were increasingly enabling the estimation of the contemporaneity of archaeological features in local sites and regions, and survey techniques were improving, the flow of new population estimations on different spatial scales has recently increased: based on proxies such as household numbers or on proxies for human activities in the past such as radiometric dates or numbers of millstones (Zimmermann *et al.* 2004; Bocquet-Appel, 2002; Zimmermann 1996; Shennan and Edinborough 2007; Müller 2007).

From a methodological point of view, seven different methods to reconstruct population sizes per square kilometre have been used by archaeologists with absolute or relative estimations for different special levels:

1. *Ecological/ethnographical estimations*: Population densities of recent non-literate societies in different ecological areas are used as proxies for similar palaeoecological areas occupied by prehistoric groups with similar subsistence techniques (Binford 2001 used recent data of foragers and the reconstruction of palaeolithic climates and environments to calculate persons/km^2).
2. *Ecological/ethnographical/archaeological estimations*: In a similar approach, the carrying capacity is reconstructed with the help of ethnographic parameters und environmental reconstructions as an upper limit of prehistoric population densities. Archaeological remains of contemporary sites are used (also with ethnographic parallels, *e.g.*, of group sizes in houses) for the lower limit of absolute population densities (cf. Hassan, 1981 for hunter-gatherer populations).
3. *Ecological/archaeological estimations*: Archaeological information is used to reconstruct the technological level of subsistence economies of prehistoric societies. For reconstructed environments, the productivity of prehistoric groups is calculated according to the technological basis and transferred into population figures and rates (cf. Poulsen 1983 for the Nordic Bronze Age; Buck 1985 for East German Lusatian societies).
4. *Archaeological estimations based on data from burials*: For periods and areas of interest, the loss of burials through prehistory and history is reconsidered by source criticism and the living population is reconstructed according to anthropological data from the burials (*e.g.* Struve 1979, 50 and Kristiansen 1985, 126 for the Nordic Bronze Age).

5. *Archaeological estimations based on data from domestic sites (houses)*: The number of contemporaneous households is reconstructed in 'well researched' test areas, the determined number of houses is applied to other settled regions and the household size is then estimated by ethnographic comparisons (*e.g.* Zimmermann 2004 for the Early Neolithic in West Germany and Müller 2006 for Bosnia).
6. *Archaeological estimations based on data from domestic sites (sites):* Reconstructed population sizes of settlements on the basis of contemporaneous houses are transferred into figures about inhabitants/hectare and this value is then applied to settlement areas, detected, *e.g.* by surveys (*e.g.* Russell 1958; Wilkinson 1999).
7. *Archaeological estimations based on data from single object types*: The number of inhabitants of sites is reconstructed by the use time and the processed amount of cereals, *e.g.*, from contemporaneously used millstones, which is then transferred to possibly nourished individuals, whose number is calculated by nutrition models (*e.g.* Castro *et al.* 1998).
8. *Palaeodemographic estimations based on data from burial sites*: The age/sex ratio of burials at cemeteries can be used to recalculate the fertility rate and end up with relative estimations about the demographic development in an area (Bocquet-Appel 2002).
9. *Estimations based on indirect proxies from radiocarbon-values or pollen analysis*: Sum calibrations of radiometric data are used as indicators of human activity, which could be translated into a model of the relative development of demographic values (*e.g.* Shennan and Edinborough 2007). A correlation with palynological human impact indicators is possible (*e.g.* Hinz *et al.* 2012). A scaling of results by population estimations in test areas (derived by other estimation methods) might be possible to translate the relative values into absolute population figures (*e.g.* Müller 2009b).
10. *Estimations based on mutation rates of DNA*: The mutation of haplotypes might indicate the relative population numbers for selected areas (*e.g.* Brotherton *et al.* 2013).

While with some methods absolute population estimations are possible (methods 1–7), others end up with relative figures (8–10). A survey of analyses already conducted for Europe and the Near East showed that at least 153 estimations of methods 1–7 are known from the literature (Müller, i. prep.; data access: www.johanna-mestorf-academy.uni-kiel.de). The scope ranges from 'local' to 'global' scales, meaning from single sites or more densely populated core areas, to calculations which also include non-inhabited parts of the wider landscape (Wendt *et al.* 2010, 324–5). With only a few exceptions, most of these studies are very sophisticated and include a large variety of variables in the analyses. Thus, the analyses of type 1–7 were used as relevant methods to calculate population densities on a broader scale.

Survey on population estimations: from the Near East to Scandinavia

With the theoretical assumptions about the value of population calculations in the background, with knowledge about the consequences of population densities for the social anthropological and historical reconstruction of human societies and with knowledge about differences in methodologies for the reconstruction of population densities, I would like to move on to real facts and models. For this purpose, the manifold reconstructions of population calculations were included in a database and mapped against timescale and persons/km^2. A differentiation was made between case studies, which deal with more densely settled core areas (labeled 'local'), and such that also include unsettled areas into the calculation (labeled 'global'). For example, the Central Bosnian Visoko Basin (35 km north-west of Sarajevo) was an agrarian core area (local) during the Bosnian Late Neolithic

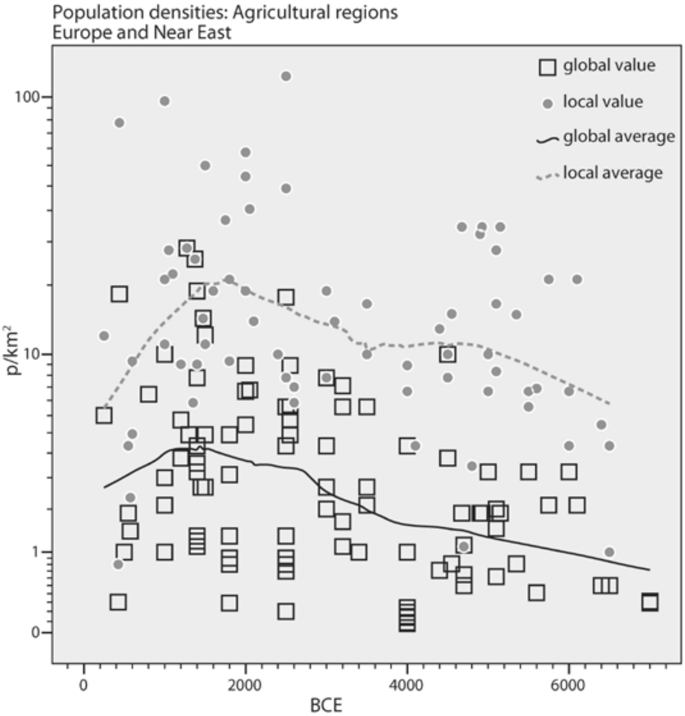

Fig. 17.1. Observed profiles of population densities in accordance with archaeological estimations on 'local' (core areas) and 'global' (regions including non-settled or less settled areas) scales, using a Loess fitting procedure (Epanechinkov, 50% point matching). The lines represent the average expectations based on the archaeological analyses. European and Near Eastern agrarian regions.

with population densities up to 30 p/km² (Müller 2007), while all of Bosnia, including core areas like the Visoko Basin as well as parts of the Dinaric Alps and other more thinly settled areas (global), yielded population densities of only up to 2.5 p/km².

The survey of all available analyses of agrarian regions for Near Eastern, South East European, Central European and Scandinavian societies displays general tendencies (Fig. 17.1):

- The population densities on a 'global' scale rise from 0.7 p/km² around 7000 BCE to 4.3 p/km² around 1400 BCE.
- A higher rate of population increase is visible between *c.* 4000–2700 BCE (0.0013 p/km² per century in contrast to 0.000037 before [7000–4000 BCE] and 0.000069 p/km² after [2700–1400 BCE]).
- Population densities in the core areas increase from 7 p/km² around 6000 BCE to 10.9 p/km² around 1400 BCE. On this general scale, the difference between 'core' and 'periphery' is reduced from 7× denser population figures from 'core' areas to summarizing 'global' values around 6000 BCE to 2.7 around 1400 BCE.

The huge variability of figures for single case studies, which is also displayed in the scatterplot, is not due to the application of different methods, but obviously due to a historical variability in different areas. Especially the variability of population densities in core areas shows significant differences. Furthermore, we should note that the demographic values presented are only valid in agrarian regions (compare Fig. 17.6). The calculation of overall density values has to take the affected area into consideration (see below).

Keeping this in mind, initial interpretations of the data should be allowed. The steady

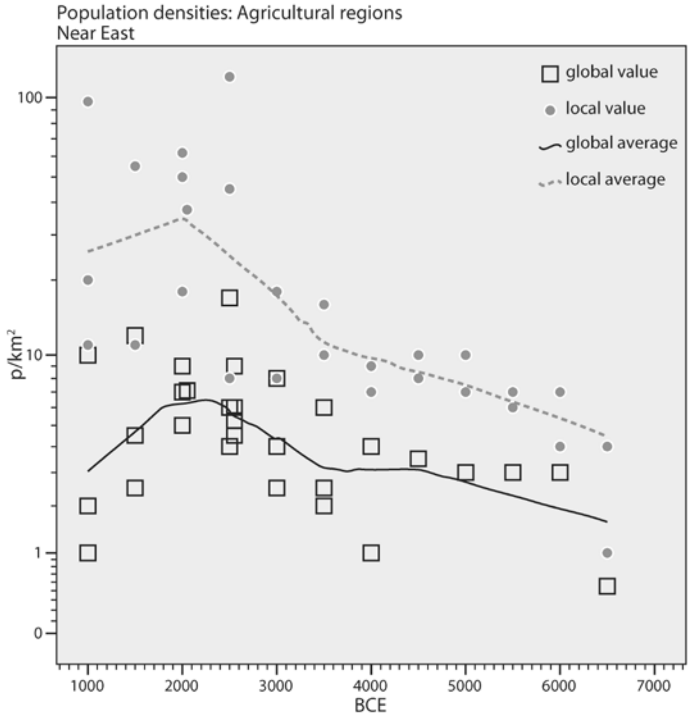

Fig. 17.2. Observed profiles of population densities in accordance with archaeological estimations on 'local' (core areas) and 'global' (regions including non-settled or less settled areas) scales, using a Loess fitting procedure (Epanechinkov, 50% point matching). The lines represent the average expectations based on the archaeological analyses. Near Eastern agrarian regions.

rise of population size in the agrarian occupied areas of the Near East and Europe does not, 'globally' spoken, indicate a huge population pressure. The tendency of decreasing differences between 'core' and 'global' values might indicate inner-area *landnam* processes, which led to a further spread of the population – also in formerly uninhabited areas of already occupied regions. The faster rate of population increases in the fourth millennium BCE might be linked to the Near Eastern urban revolution and changing technologies in Europe. To evaluate these first statements, I would like to have a closer look at the Near Eastern, South-east European and Central European/Scandinavian data separately.

Figure 17.2 indicates the Near Eastern population development in their agrarian used areas:

- 'Globally spoken', an increase in population densities is displayed from 1.7 p/km² around 6500 BCE to 6.3 p/km² around 2300 BCE.
- A steeper increase is visible, starting around 3500 BCE and lasting until 2300 BCE (0.00256 p/km² per century), in contrast to a discontinuation of population development for the previous *c.* 500 years.
- In core areas the value rises from 4.1 p/km² to 35 p/km², thus the difference between 'global' and 'local' values increases from 2.4 to 4.7.

Clearly, the results could be linked to the urbanization processes in the Near East, which started with significant population increases around 3500 BCE after a period of stagnation (cf. Pollock 1999). The increasing concentration of the population in core areas in contrast to the general Europe/Near East results is displayed in Figure 17.1. Here the difference between Near Eastern urbanization and the other regions becomes visible and makes the

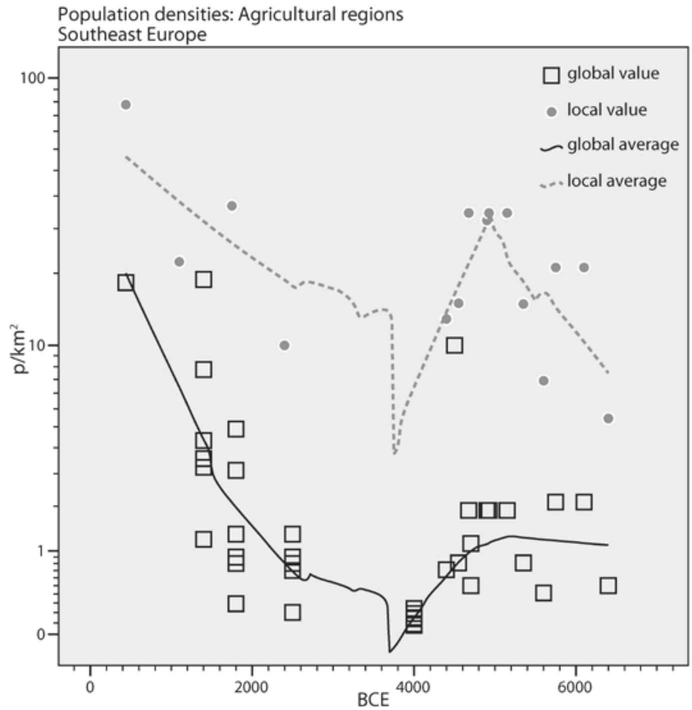

Fig. 17.3. Observed profiles of population densities in accordance with archaeological estimations on 'local' (core areas) and 'global' (regions including non-settled or less settled areas) scales, using a Loess fitting procedure (Epanechinkov, 50% point matching). The lines represent the average expectations based on the archaeological analyses. South-east European agrarian regions.

historical difference between the Near East and Europe also detectable in population figures.

Population density calculations for South-east Europe are quite rare, but the pattern (Fig. 17.3) seems plausible in light of archaeological background information with a 'global' increase of 1 p/km² to 1.2 p/km² between *c.* 6200–4500 BCE, a decrease until 4000 BCE and an increase again (*e.g.* 1000 BCE 10 p/km²). In contrast to other regions, the concentration of the population in core areas is tremendous and even increased in the two identified demographic periods (*e.g.* 6200–4500 BCE: 8–33p/km², thus from 8× to 30× denser). The described values are supported by calculation rates dependent on the interpretation of dates from cemeteries (Müller 2013).

For Central Europe and Scandinavia, 'global' population estimations or such for 'core areas' are rare. Thus, Figure 17.4 displays only weak evidence with general tendencies, which are further developed with other analyses by the author (Müller 2013). Nevertheless, on a 'global' scale a rise of population densities from 1.1 p/km² around 5100 BCE to 2.2 p/km² around 3100 BCE is visible, while a main increase is indicated from 3500 BCE to 3100 BCE (1.6–2.2 p/km²). Later on, an increase to 2.5 p/km² around 1500 BCE might indicate the increase during the Early Bronze Age. Concerning the core areas, high densities are reflected in Linear Pottery times (5100 BCE, 10 p/km²), reduced to lower numbers around 4000 BCE (4–5 p/km²) and rise to comparable levels again around 3100 BCE. During the next two millennia we observe population concentrations of about 15 p/km² in the cores.

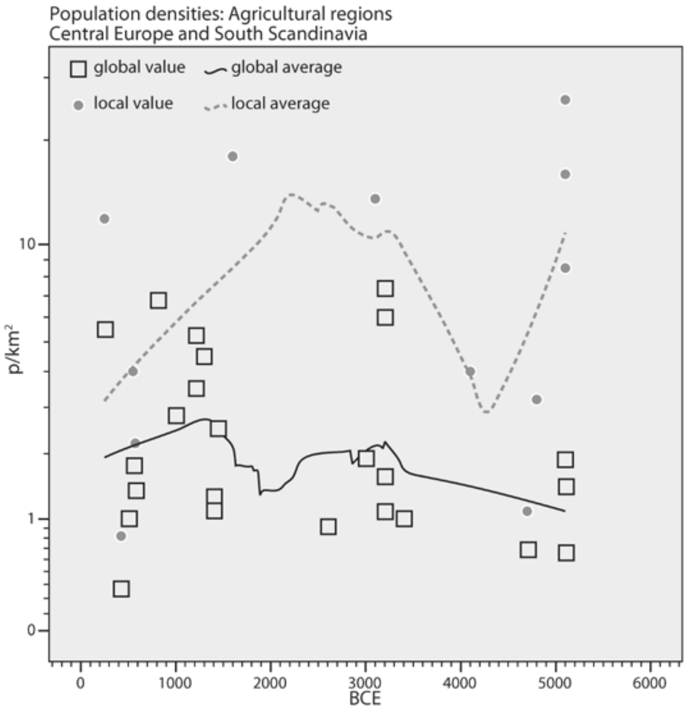

Fig. 17.4. Observed profiles of population densities in accordance with archaeological estimations on 'local' (core areas) and 'global' (regions including non-settled or less settled areas) scales, using a Loess fitting procedure (Epanechinkov, 50% point matching). The lines represent the average expectations based on the archaeological analyses. Central European and south Scandinavian agrarian regions.

Absolute population values for Europe and the Near East

While until now our results proceed from the areas of Europe and the Near East which were occupied by agrarian societies, our described population estimations *have* to be corrected by the spatial increase of agrarian areas over time and, in addition, by population values for areas which were still used by foragers (Fig. 17.5).

For simplicity, I calculated with a value of 0.1 p/km² for foraging communities on a 'global' scale (compare Hassan 1981; Binford, 2001; Zimmermann 1996). Thus, by the multiplication of the agrarian areas (km²) with the relative density of the agrarian population (p/km²), an absolute value of inhabitants (p) on the agrarian areas was calculated. With the addition of the foraging population, probably left over in the non-agrarian but settled areas, an overall value for the absolute population in Central Europe and South Scandinavia, South-east Europe and the Near East was achieved. By the division of these values by the square kilometres of South-east Europe (here 1,087,500 km²), Central Europe and south Scandinavia (here 1,613,000 km²) and the Near East (here 2,400,000 km²), relative population figures for the areas were calculated for the different time periods.

A model also led to the calculation of absolute and relative values for all of Europe (here 10,050,000 km², excluding Iceland): I observed the agriculturally settled areas of Europe and calibrated their population densities with the values for densities of agricultural areas in South-east European and Central Europe/south Scandinavian. In all cases, the estimation of the spatial distribution of agriculture was made on the basis of different sources (*e.g.* Müller 2009a; Scarre 2009, 435; Guilaine 2007, 171; Lüning 2007, 179), summarized in Figure 17.6.

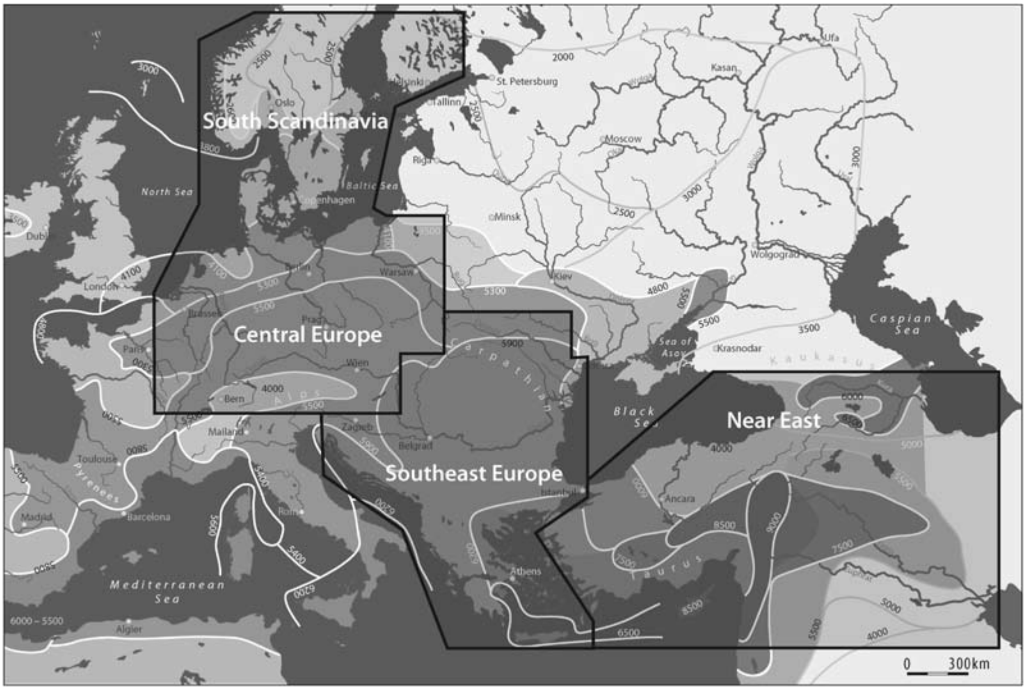

Fig. 17.5. The distribution of agrarian regions in Europe and the Near East in relation to the supra-regions: Near East (NE) about 2,400,000 km²; South-east Europe (SEE) about 1,087,500 km²; Central Europe and south Scandinavia (CE/SSc) about 1,613,000 km². Europe includes 10,050,000 km² (without Iceland).

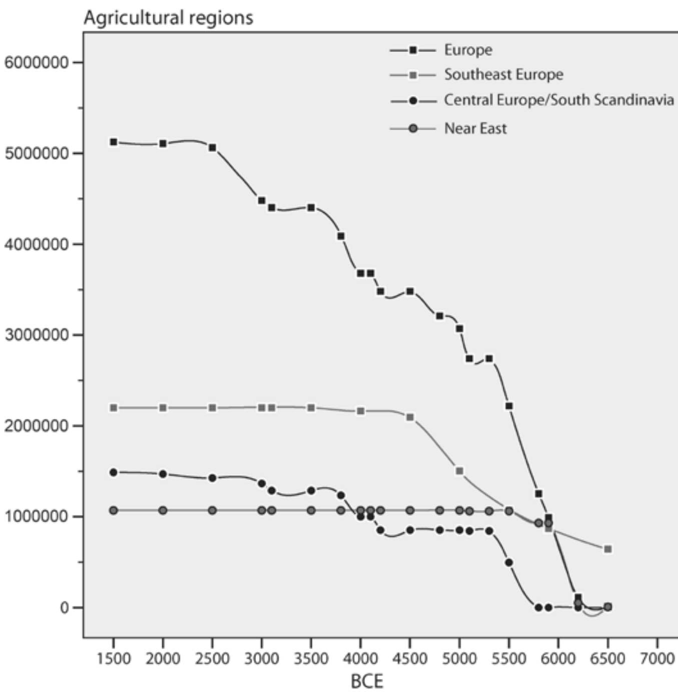

Fig. 17.6. The increase in agrarian regions for the units of analyses (interpolation line: spline). In the part of the Near East which is used here (cf. Fig. 17.5), nearly the whole area is influenced by agricultural practices around 4500 BCE, in South-east Europe this occurs already at about 5500 BCE. The values of population densities from Figs 17.1–4 have to be calibrated by the size of agrarian regions displayed in this graph in order to end up with absolute and relative population estimations for the geographical units.

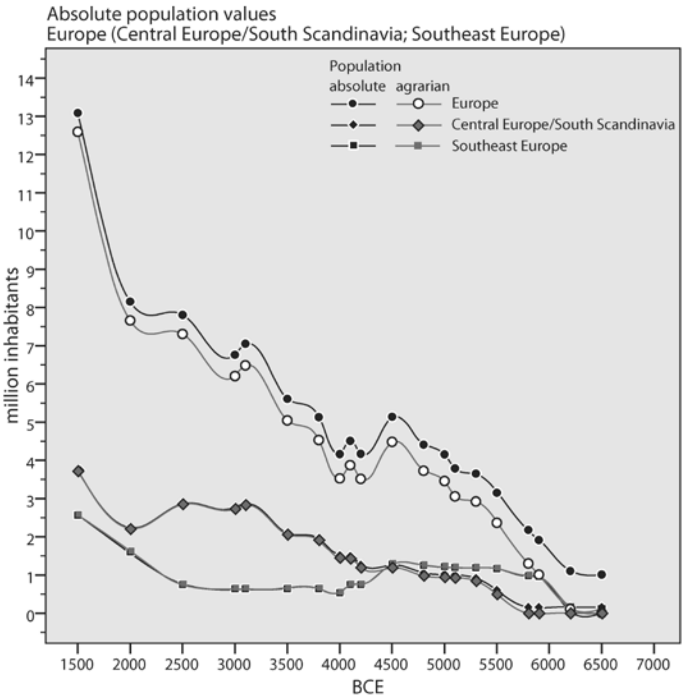

Fig. 17.7. Absolute population values and values for the agrarian population in Europe (interpolation line: spline).

The results of the population calculations are displayed in Figure 17.7–9. I would like to interpret the results as follows:

From 1 million to 8 million in Europe (6500–2000 BCE)

The size of the population in Europe increased from *c.* 1 million inhabitants around 6500 BCE to a population of *c.* 8 million around 2000 BCE (Fig. 17.7). Already from the beginning of agricultural practices, foraging populations are quantitatively negligible in comparison to the immense and fast growing numbers of horticulturalists and agriculturalists. This is not only observed on a continental scale, but also for Central Europe/south Scandinavia as well as South-east Europe.

Increase and decrease of European populations

While in South-east Europe a continuous development of early agrarian communities is visible with high population values of about 1–1.3 million (mainly agrarian) inhabitants, in Central Europe such values are reached much later due to a later neolithization process. But around 4500 BCE the situation changed between both sub-regions of the continent. While in South-east Europe the population numbers decreased by more than 0.5 million inhabitants, in Central Europe/south Scandinavia an increase by more than 0.5 million inhabitants and until 3800 BCE by more than 1 million inhabitants is displayed (Fig. 17.7). The main shift is, in general terms, associated with a population decrease visible on a European scale, which is followed by a new increase after *c.* 3800 BCE (Fig. 17.7).

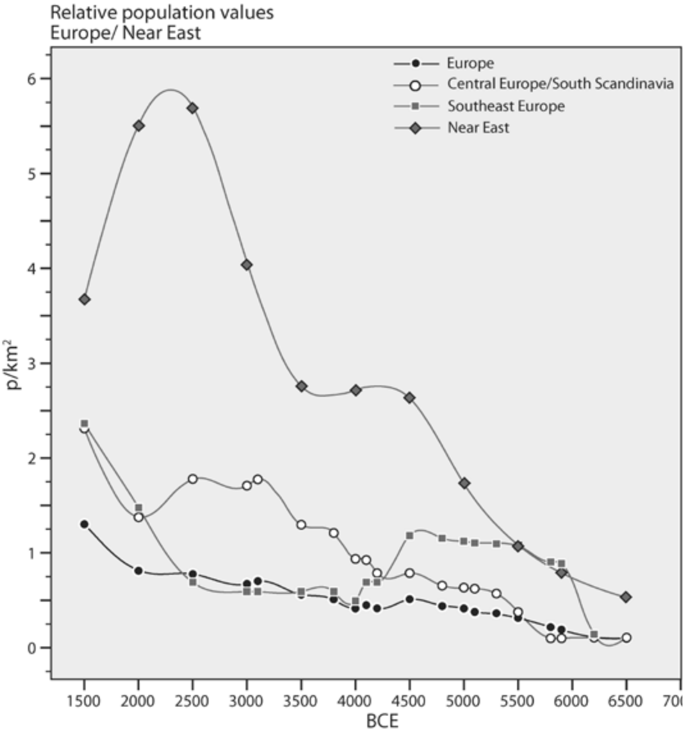

Fig. 17.8. Relative population values in Europe and the Near East from 6500–1500 BCE (interpolation line: spline).

From *c.* 3500 to *c.* 2500 BCE, *c.* 3 million inhabitants lived in Central Europe and south Scandinavia. A possible population decrease in these regions is followed again by a population increase after 2000 BCE. In the meanwhile, a population increase started in South-east Europe around 2500 BCE, which is also responsible for the general European population increase. Around 1500 BCE, we are talking about 4 million people in Central Europe/South Scandinavia, 2.5 million in South-east Europe, and *c.* 13 million on the entire European continent (Fig. 17.7). The calculation of relative population densities are in line with the absolute population values (Fig. 17.8).

Technology and social formation matters

The shifts in population dynamics are, in my opinion, due to technological and social changes within the societies. While the introduction of horticultural practices to South-east Europe and Central Europe triggered the population growth around *c.* 6000 BCE and after 5500 BCE, the population decrease after *c.* 4500 BCE was due to the social problems of, *e.g.*, Late Neolithic and Early Chalcolithic societies in South-east Europe (cf. Windler *et al.* 2012). In Central Europe, the population increase and occupation of new areas could be associated with changing agrarian technologies (slash and burn in North Central Europe and south Scandinavia), changing track systems and the introduction of the ard and perhaps also the wheel (leading to significant impulses with a stair-like demographic growth rate) (*e.g.* Schier 2009; Mischka 2011; Feeser *et al.* 2012). The overall success story

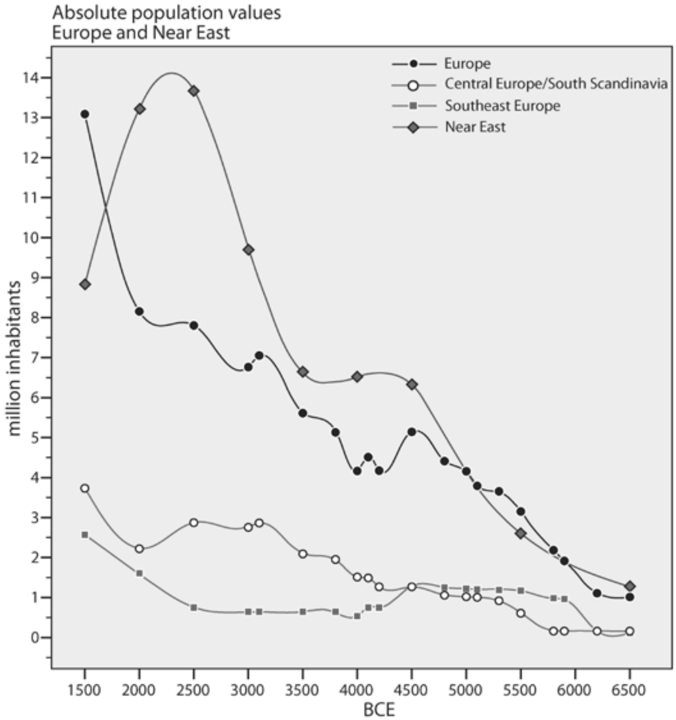

Fig. 17.9. Absolute population values in Europe and the Near East from 6500–1500 BCE (interpolation line: spline).

of these new types of Neolithic societies is represented in a continuous population increase, which ceased after 2500 BCE, perhaps because of internal problems. Perhaps the change from dominating regional exchange systems to sub-continental networks (*c.* Bell Beakers) involved a series of crises, influencing the population rates. But later on, the formation of Bronze Age societies led to new huge increase rates.

Near Eastern populations: 14 million?

Europe is a different story in comparison to developments in the Near East region. The comparison of relative population densities (Fig. 17.8) displays the much higher density rates in the Near East. Only during the first neolithization of South-east Europe is the development of qualitative population density similar to the Near East, also with comparable social developments. The continuous Near Eastern population growth comes to a halt around 4500 BCE, resuming again around 3500 BCE. As in Europe, these demographic developments might be associated with technological and social changes: first the difficulties in introducing irrigation agriculture around 4500 BCE and then the subsequent urbanization processes as a solution to new economic and societal tasks after 3500 BCE. The observed decrease in population after 1500 BCE is due to values from the Late Bronze Age 'dark ages' (Kirleis and Herles 2007; Roberts *et al.* 2011), which appear to indicate a demographic disaster. Overall, the Near East outnumbers Europe not only in relative, but also in absolute population values since at least 3000 BCE (Fig. 17.9). As an

example, around 2500 BCE about 14 million people lived in the Near East: the population was twice the size of the population of Europe, while the extent of the area in the Near East amounted to only a quarter of the European surface.

Conclusion and further perspectives

One main conclusion can be put forth from the presented results: the evaluation of population densities from 'local' to 'global' spatial scales and in a diachronic manner is possible. The differences in relative population densities describe different patterns of social organization: Development in the Near East and Europe are clearly divergent. The only exception is the starting point. Demographic values for the early neolithization of South-east Europe are comparable with the Near East. Later on, the difference is obvious. While proto-urbanization and urbanization define settlement organization in Mesopotamia and the concentration processes within the settled areas are correlated to the overall demographic development, in Europe a different story evolves. In South-east Europe, high concentration values are followed by a breakdown of the society, which is contemporaneous with new inputs to the Central and North European development. Obviously, new settlement patterns with lower concentrations of people and larger land areas settled by agrarian people characterized the European answer to unnecessary social stress in core zones – for centuries.

Population increases (and decreases) are clearly linked to technological changes and the social constitution of societies. Not only the introduction of horticulture and agriculture, but also changing subsistence and communication technologies (*e.g.* slash and burn, ard, traction, wheel) influenced population densities in Europe like other technologies and processes (irrigation, urbanization) changed the demography of the Near East.

Since we are now confronted with absolute population values, we could begin to use isotope analyses and palaeogenetics for the reconstruction of mobility within and between societies. Different attempts have been made; a first provisional integration of population reconstruction and isotope analyses is undertaken in a different, but linked study (Müller 2013). Many similar investigations are in progress in order to integrate multi-proxy approaches into archaeological research. The reconstruction of population values is merely one part of such approaches.

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